

## SUMMARY OF MUNICIPAL WATERSHED MANAGEMENT SURVEYS IN THE EASTERN UNITED STATES

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**ABSTRACT.** The U.S. Forest Service conducted two municipal watershed management surveys in the eastern United States, using mailed questionnaires, to (1) determine the importance of surface water supplies, (2) inventory the land uses allowed in these watersheds, (3) inventory the nature and extent of various land-management problems related to water supplies, and (4) determine what information and management practices are needed to improve watershed management and water supplies.

THE U.S. FOREST SERVICE, through its Northeastern and Southeastern Forest Experiment Stations and the Southeastern Area Office for State and Private Forestry, conducted two municipal-watershed-management surveys in the eastern United States, in the Northeast in 1968 and in the Southeast in 1972 (fig. 1). The Southeastern study also included Arkansas, Louisiana, Oklahoma, and Texas; but for the purposes of this summary only those states east of the Mississippi River are included.

Both studies had basically the same objectives: (1) to inventory the land uses allowed in municipal watersheds; (2) to inventory the nature and extent of various land-management problems in these watersheds; and (3) to determine what information, research, and types

of management practices are needed to improve the management of municipal watersheds.

Different definitions of a municipal watershed were used in the two surveys, and this influenced some of the results. In the Southeast, a municipal watershed was defined as *any* watershed that supplied surface water to a community, whether or not any portion of the watershed was owned or controlled by a water-supply agency (fig. 2). In the Northeast, a municipal watershed was defined as one in which a water-supply agency owned land and "the primary function is to provide domestic water supplies, whether in public or private ownership, including protection land surrounding reservoirs and forest land managed for the protection of well fields and their

Figure 1.—The areas for which municipal watershed management was surveyed and summarized.

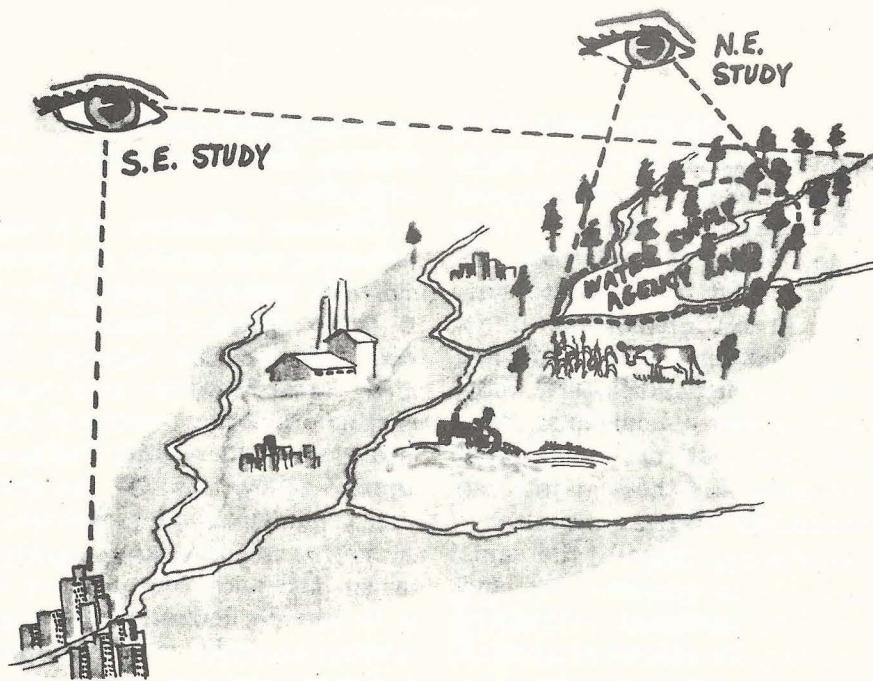
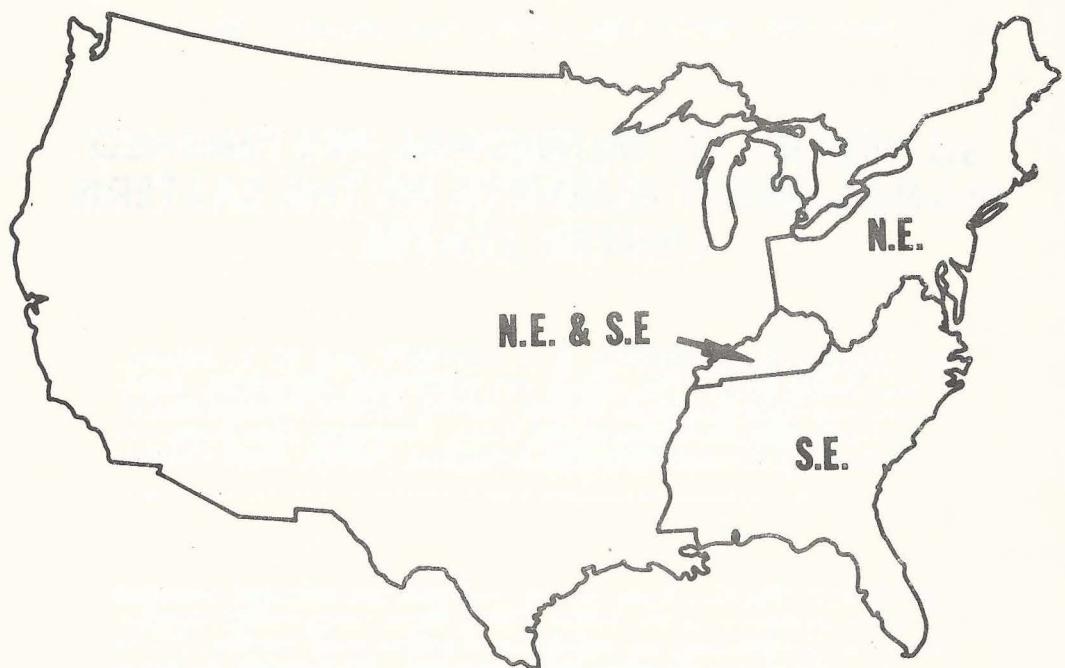


Figure 2.—The types of watershed surveyed.

recharge areas". A municipal watershed manager, therefore, is an individual whose responsibility is the care and management of such lands (*Corbett 1969*). The Southeastern study did not include well fields or recharge areas. The Northeastern watersheds sampled were predominantly forested, whereas the Southeastern watersheds contained a mixture of land uses.

### SURVEY PROCEDURES

In both studies, questionnaires were sent to municipalities and water-supply companies. In addition, in the Northeast, questionnaires were sent also to state and federal agencies. Mailing lists were compiled from available records of state and federal agencies, publications, and a previous survey. 1,332 questionnaires were mailed in the Northeastern survey and 631 in the Southeastern survey. Two months after the questionnaires were mailed, a follow-up mail contact was made with the nonrespondents. In the Northeastern study, the nonrespondents who were known to own part of a watershed were asked by phone for data on the acreage of ownership. In the Southeast, no phone contacts were made except in Georgia (*Shaw 1973*). Respondents to the Southeastern survey ranged from mayors and water-supply managers to clerks who used available data and personal knowledge to complete the questionnaires. The Northeastern survey had 78 percent response, the Southeastern survey 53 percent.

### EXTENT AND OWNERSHIP

In the states surveyed (fig. 1), at least 1,930 watersheds are used as sources of water. In the Southeast, the 337 water-supply agencies and companies that responded to the survey tapped at least 244 streams and 142 lakes and reservoirs to provide water for approximately 10,400,000 people — ap-

proximately 1,640 million gallons per day.

Several large rivers are tapped for municipal water; for example, the Chattahoochee, Tennessee, and Mississippi. In the Southeastern survey, 20 percent of the streams used had watersheds greater in area than 1,000 square miles (table 1).

Table 1.—Watershed size-class distribution in the Southeast and Northeast, in percent

Watershed size class (square miles)	Southeast	Northeast
<5	18	54
5-9	11	13
10-49	23	18
50-99	10	7
100-499	14	7
500-999	4	0
1000+	20	1

However, when one contemplates management of municipal water-supply watersheds, one must limit consideration to relatively small watersheds, where land management can be influenced by a community or a water-supply agency. The practical limit to the size of such a watershed is probably 100 square miles. In our surveys we found that most of the watersheds used were of less than 100 square miles, (62 percent in the Southeast and 92 percent in the Northeast: table 1).

The ownership mixture varies between the Southeast and Northeast. Because the Northeast watersheds all had ownership by a water-supply agency, there is a difference in the interpretations that can be made from the data. In the Northeast, approximately 29 percent or 2,000,000 acres of the total watershed areas was owned or control-

led by 750 municipalities, private water companies, and state and federal agencies. These agencies manage these areas primarily for water supply. Of this acreage, 41 percent is owned by municipalities and 13 percent by private water companies; 36 percent is under state control and 10 percent federal control. The average size of such holdings is 4.2 square miles.

However, the remaining 71 percent of the total area is managed for other purposes. This consists of private, federal, state, and local government ownerships, the mix of which is unknown.

In the Southeast, the total watershed acreage is 15 percent in municipal ownership, 1 percent state, 11 percent federal, and 73 percent private and industry. The 15 percent of municipal ownership is spread over 46 percent of the watersheds.

#### LAND MANAGEMENT

Land uses and management varied between the two regions, and this is reflected in the water problems identified. Though the Northeastern watersheds were predominantly forested, the respondents to the survey in the Southeast

estimated that forest occupied 53 percent of the watershed areas. A significant difference is that 68 percent of the Southeastern respondents estimated that 24 percent of the area was used for agriculture and 9 percent for range. This creates significant agriculture- and livestock-related water problems. For those watersheds in the Southeast with municipal ownership, the forest occurrence and area increased to 93 and 58 percent, respectively. The area of brush is 11 percent with agriculture and range lands reduced in area.

The Northeast watersheds all have forest lands which occupies 71 percent of the area (table 2). Twenty-six percent of the watersheds are 100 percent forested. An additional 25 percent are 90 to 99 percent forested.

Control of activities on land owned by water-supply agencies in the Northeast is strict: 41 percent of these ownerships are closed to use; 59 percent allow some type of recreation. The restriction of uses on other lands in these watersheds were not evaluated. In the Southeast, only 11 percent of the respondents reported all or any portion of the watershed as closed. Seventy percent of the respondents reported no restrictions on

Table 2.—Percent occurrence and area of different vegetation types on watersheds supplying municipal water in Southeast and Northeast

Vegetation type	Southeast						Northeast	
	All watersheds		Watersheds with municipal ownership <sup>1</sup>				Occurrence <sup>2</sup>	Area
	Occurrence <sup>2</sup>	Area	Occurrence <sup>2</sup>	Area				
Forest	89	53	93	58			100	71
Brush	49	12	56	11			—	—
Agriculture	68	24	66	19			13	—
Range	32	9	30	7			—	—
Other	9	2	10	5			—	—

<sup>1</sup>Watersheds that contain some municipal ownership.

<sup>2</sup>Percent of responses indicating occurrence of a vegetation type within the watershed.

<sup>3</sup>Total area of non-forest conditions: 29 percent.

<sup>4</sup>Estimate based upon voluntary comments from Pennsylvania responses.

uses. Nineteen percent reported partial restrictions.

The permissiveness of activities is generally much greater in the Southeast (table 3). This is related in part to the types of watersheds surveyed. In the Northeastern study, activities were surveyed only on watershed land owned or controlled by the water-supply agency, while in the Southeastern study the activities were related to the total drainage area, most of which is not under management for water-supply purposes.

Special attention was given to recreation activities. The Northeastern watersheds allow little boating, swimming, and water skiing. Pressures on opening these watersheds for water sports is great, and there are requests for research to determine the recreational carrying capacities of watersheds without degrading water quality. Water-supply managers are seeking informa-

tion for planning and managing recreation.

In the Southeast, a question asked was: Do you have watershed management agreements with outside landowners or other agencies? Negative answers were received from 78 percent of the respondents. However, 4 percent indicated that they had agreements with private landowners and 5 percent with the U.S. Forest Service. The remaining agreements were with industry and other federal and state agencies and were probably for water-supply or water-quality analysis.

#### HYDROLOGIC AND WATER-QUALITY DATA

The type and quantity of hydrologic data collected were similar in both studies (table 4). In the Southeast, the emphasis on water-quality data was apparent: 79 percent of the watersheds collected raw-water quality data. Sixty-nine percent reported the parameters analyzed, including temperature, pH, turbidity, color, bacteria, suspended matter, and chemical constituents. The quantity of hydrologic data is limited for both regions.

**Table 3.—Percent of watersheds on which various activities are allowed in the Southeast and Northeast**

Activity	Southeast <sup>1</sup>	Northeast <sup>2</sup>
Fishing	87	39
Hunting	71	40
Agriculture	60	13
Camping	50	9
Grazing	49	( <sup>1</sup> )
Boating	48	11
Swimming	44	4
Timber production	44	54
Horseback riding & hiking	39	14 & 35
Water skiing	27	4
Mining	16	( <sup>1</sup> )
Snow skiing	7	7
Ice skating	( <sup>1</sup> )	8
Other	3	1

<sup>1</sup>Activities occurring somewhere in the total watershed, whether or not land was owned and managed for water-supply purposes.

<sup>2</sup>Activities only on land owned by water-supply agencies.

<sup>3</sup>Pennsylvania only.

<sup>4</sup>Not asked in survey.

**Table 4.—Percent of watersheds on which different types of climatic and hydrologic data are collected**

Type of data	Southeast	Northeast
Raw water quality	79	( <sup>1</sup> )
Water temperature	53	( <sup>1</sup> )
Precipitation	32	39
Air temperature	21	29
Streamflow	22	18
Evaporation	6	4
Humidity	4	3

<sup>1</sup>Not asked in survey.

## MAJOR PROBLEM AREAS

Municipal watersheds in the East are experiencing a variety of water problems. Corbett (1969) reported that 72 percent were concerned with water quality or water yield. In the Southeast, water quality is the biggest problem, followed by seasonal distribution of flow and total water yield (table 5). Although the Southeast is generally considered a water-abundant area, survey results indicated that 50 percent of the municipalities are concerned with seasonal distribution and yield problems. The seasonal distribution problem was reported primarily by communities that drew water from streams and lacked reservoirs.

Where water quality was a problem, the respondent was asked to indicate the sources of contamination (table 6). The leading source in the Southeast was agriculture and livestock, and in the Northeast municipal and recreation sources were of about equal importance. Municipal sources were also important in the Southeast, followed by recreation and industry. Pollution from farms in the Northeast was lumped with other sources and was not as common a problem as in the Southeast, but where it did occur it presented an important water-quality problem. Other than recreation, forest-related activities were a small percentage of the source of water-quality problems.

Table 5.—Percent of watersheds that indicate broad water-supply problems

Problem	Southeast	Northeast
Water quality	42	59
Seasonal distribution	29	153
Total yield	21	

<sup>1</sup>The Northeastern survey did not differentiate between seasonal distribution and total yield.

Table 6.—Pollution sources within municipal watersheds, in percent of watersheds reporting a source of pollution

Pollution source	Southeast	Rank	Northeast
	Percent	No.	Percent
Agriculture & livestock	39	1	<sup>1</sup> 13
Municipal	30	2	38
Recreation	22	4	36
Industry	22	3	<sup>2</sup> 13
Mining	10	7	—
Logging	9	6	9
Wildlife	7	8	—
Roads	7	9	—
Woodland grazing	1	11	—
Fire	1	10	—
Other	<sup>3</sup> 30	5	<sup>4</sup> 30

<sup>1</sup>Based upon voluntary comments from Pennsylvania respondents.

<sup>2</sup>Industry included mining in Northeast.

<sup>3</sup>Other causes included color, odor, and taste from algae, swamp drainage, and urbanization.

<sup>4</sup>Other causes dealt primarily with water color, odor, and taste from algae, drainage from swamps and runoff from farms, road salting, and wildlife.

Water supply problems are not exclusively related to forest management, but forest practices and forest uses do have a role in accentuating or alleviating these problems.

## INFORMATION NEEDS

In the Southeastern survey, respondents were asked what types of forest-related information would be useful in making future decisions about their watersheds. The impact of forest management on the chemical composition of water was ranked highest (table 7).

They were also asked what land management information and methods would help them meet their water needs. Water quality again came to the forefront, water yield second (table 8). About 25 percent of the respondents were interested in technical assistance to improve land management.

Comparisons were made between Southeastern watersheds with and without

Table 7.—Information thought useful for all Southeastern watersheds

Impact of forest management on --	Rank: Sum of frequency an information need was ranked first, second, or third in importance		Responses indicating an information need
	No.	Percent	
Chemical composition	71	31	
Turbidity	59	34	
Biological	54	27	
Water yield	51	24	
Recreation — bacteria	44	33	
Recreation — chemical composition	32	22	
Water yield timing	24	15	
Temperature	6	8	
Other	1	1	

Table 8.—Management information needed for future decisions in Southeast  
[Percent of responses indicating need for land-management information  
or technical assistance.]

Information needed	All watersheds	Watersheds without municipal ownership	Watersheds with municipal ownership
Land management for water quality	33	28	38
Land management to increase water yields	26	22	31
Technical assistance	25	18	33
Land management for water yield timing	10	9	12

Table 9.—Publications received, by percentage respondents

Publication	Southeast	Northeast
Water & Wastes Engineering	70	49
J. American Water Works Assoc.	64	65
Public Works	53	( <sup>1</sup> )
J. Water Pollution Control Fed.	29	( <sup>1</sup> )
Industrial Water Engineering	20	( <sup>1</sup> )
Farm Journal	7	( <sup>1</sup> )
J. Soil & Water Conservation	1	19
Southern Lumberman	1	( <sup>1</sup> )
Journal of Forestry	1	17
U.S. Forest Service Research Papers	1	15
J. New England Water Works Assoc.	( <sup>1</sup> )	24
Other	6	5

<sup>1</sup>Not asked in questionnaire.

out municipal ownership. The only comparison that appeared to show a significant difference was in land-management information and methods (table 8). Managers of watersheds with municipal ownership appear to have a significantly higher interest in land management (80 percent level of confidence). The biggest difference was in technical assistance: 33 percent of those with municipal ownership showed interest.

#### PUBLICATIONS RECEIVED

In the Southeastern survey, respondents were asked to list the journals and publications they receive that help them in managing their watersheds. The top five publications were trade journals that concentrate on water-supply management (table 9). Few respondents received publications that concentrate on land management. This indicates that land-management information is not reaching these people.

They were asked if they wanted to be put on a mailing list for publications relevant to land management on municipal watersheds. Sixty percent of the respondents requested being put on such a list.

#### CONCLUSIONS

Municipal watersheds pose some challenging problems and opportunities in land management. Water-supply managers recognize the relationship between

land management and water supply. Most watersheds are small enough that towns could influence the management of land within these watersheds. Consistently, water quality was the first concern, followed by water yield and recreational impacts. The leading causes of water-quality degradation were agriculture and livestock grazing, municipal, industrial, and recreational sources.

Interest in the impact of land use and management on the water resource is strong. Information is needed about the impact of forestry on chemical composition of water, turbidity, biological quality, and water yield. There is an interest in technical assistance in helping alleviate some of the problems.

The land management story may not be reaching the water-supply manager, and this may be preventing the improvement of management on these watersheds. More articles should be aimed at this audience through the trade magazines.

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